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Social learning and community-based strategies to promote Sustainable Development Goals (SDGs)

The case of food security and climate change in rural areas

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Summary

Achieving the Sustainable Development Goals (SDGs) requires taking strategic actions, the identification of which depends, among others, on transdisciplinary, community engagement, and social learning. Helping communities to build sustainable strategies is complex (it consists on many different and connected processes); especially in communities experiencing food insecurity and vulnerability due to their biophysical situation and their socio-cultural conditions, where it is difficult to access education and trigger collective action. Despite a significant emphasis on a participatory approach, a lack of applicable educational tools for community-based strategy development remains, especially concerning social learning with respect to food security and climate change in the context of vulnerable rural zones.

So far, only a few case studies analyzed the value added of integrating in-depth pedagogical processes and implementing educational tools to create sustainable development strategies at the community level. To close this gap, the overall objective of this work is to develop educational tools and improve pedagogical processes that enhance social learning, with particular regard to realizing SDGs 2 and 13 (food security and climate change actions).

The hypotheses guiding this work are: a) a constructivist pedagogical frame can be operationalized as an educational tool to enhance social learning in SDGs projects; and b) operationalizing social learning processes can increase the quality of data and project output of sustainable development projects.

In this dissertation, a cumulative approach integrating four peer-reviewed scientific articles is structured as follows:

Chapter 1, the introduction, outlines the research problem embedded in the sustainable development paradigm as well as the need for, and challenges of, social learning process.

Chapter 2 explores the theoretical framing with respect to social learning conceptualization and education theories in further detail, providing the theoretical foundation of this dissertation. The approach adopted in the dissertation is related to the concept of Critical Education embedded in a constructivist paradigm that analyses the importance of the reflection of a practice of conscious, questioning, and forward-thinking education.

Chapter 3 provides the research design. This work was completed across three complementary methodological phases, and the field research was embedded in three international research projects. These research projects offered a fertile environment to investigate and address the research questions because they sought to create sustainable development strategies in different rural communities for not just food and nutrition security (SDG 2), but also climate change adaptation (SDG 13). The eight study cases in total were based on vulnerable smallholder's communities in South America (Brazil) (4 cases) and Sub-Saharan Africa (Tanzania) (4 cases).

The Results section (**chapter 4**) is the main body of this dissertation and comprises four peer-reviewed journal articles. Subsection 4.1 provides a conceptual base of social learning (articles 1 and 2). Subsection 4.2 provides an operational base of social learning (article 3). Subsection 4.3, brings a final assessment as a complementary process for social learning (article 4).

The first and second articles provide the conceptual basis for all subsequent studies presented in this dissertation. Through case studies in vulnerable Brazilian communities, psychological and pedagogical aspects of social learning to develop community-based strategies were identified. Four study cases were conducted using structured and semi-structured interviews (n=50).

Based on the findings of the first and the second articles, the third paper brings the design and operationalization of educational tools to increase project social learning (participation and ownership). Here case studies in Tanzania are presented, where an innovative educational tool was developed to engage community voices in creating local solutions to food insecurity with a total of 270 residents. This educational tool was developed and tested 16 times, to assess its acceptance, applicability, and replicability in four remote rural communities.

The fourth article analyses the potential effects of a sustainable strategy integrating community-based and research-based assessments as complementary process of social learning. A case study using Scala tools was developed in Tanzania rural communities.

Chapter 5 is a synthesis of results. Each subsection provides answers to one of the research questions based on the theoretical and empirical finding produced in the four publications. Through the research findings, the hypothesis cannot be rejected.

Chapter 6 provides conclusions, highlighting the key messages of the knowledge developed in this dissertation. Furthermore, in this section, the limitations and aspects needing further study are listed.

The main conclusions are summarized as follows: The constructivist pedagogical frame is appropriate for operationalizing an educational tool to enhance social learning in SDGs projects. This finding not only contributes to better understand the mechanisms that enhance social learning, but also represents an advance in the theoretical links between social learning and the Habermas and Freire theories. The social learning process is possible following three main steps. The primary pedagogical step for social learning processes in SDGs projects is to identify and recognize this community knowledge and mental schemes accurately (article 1 and 2). Then, the second pedagogical step concerns the development of local

solutions by community members based on a critical understanding of their own life conditions (Codification and Decodification process based on mental schemes transformation). Therefore, through a process Conscientization, a reframing of the community's future can be created, potentially increasing ownership (article 3). Finally, a third step to promote SDGs projects enhancing social learning is to compare the perceptions of the community and research experts regarding SDG strategies. These are complements to evaluate potential effects of project strategies enhancing the deliberative character of social learning (article 4). These three steps promote the multi-actor dialogue for community-based strategies creation while enriching the understanding of complex situations that the sustainable development projects must handle.



Zusammenfassung

Die Erreichung der Ziele für nachhaltige Entwicklung (Sustainable Development Goals, SDGs) erfordert strategische Maßnahmen, deren Identifizierung unter anderem von transdisziplinärem, gesellschaftlichem Engagement und sozialem Lernen abhängt. Gemeinden dabei zu helfen, nachhaltige Strategien zu entwickeln, ist komplex (sie besteht aus vielen verschiedenen und miteinander verbundenen Prozessen); dies trifft insbesondere auf Gemeinschaften zu, die aufgrund ihrer biophysikalischen Situation und ihrer sozio-kulturellen Bedingungen, in denen es schwierig ist, Zugang zu Bildung zu erhalten und kollektives Handeln auszulösen, mit Ernährungsunsicherheit und -gefährdung konfrontiert sind. Trotz der deutlichen Betonung eines partizipativen Ansatzes in der Theorie, bleibt ein Mangel an leicht anwendbaren pädagogischen Instrumenten für eine gemeinschaftsbasierte Strategieentwicklung bestehen, insbesondere in Bezug auf soziales Lernen im Rahmen von Ernährungssicherheit und Klimawandel im Kontext gefährdeter ländlicher Gebiete.

Bislang analysierten nur wenige Fallstudien den Mehrwert der Integration von tiefgreifenden pädagogischen Prozessen und der Implementierung von Bildungsinstrumenten, um nachhaltige Entwicklungsstrategien auf Gemeinschaftsebene zu entwickeln. Um diese Lücke zu schließen, ist das übergeordnete Ziel dieser Arbeit die Entwicklung von pädagogischen Instrumenten und die Verbesserung pädagogischer Prozesse zur Verbesserung des sozialen Lernens, insbesondere zur Verwirklichung der SDGs 2 und 13 (Ernährungssicherheit und Klimaschutzmaßnahmen).

Die Hypothesen, die diese Arbeit leiten, sind: a) ein konstruktivistischer pädagogischer Rahmen kann als pädagogisches Instrument operationalisiert werden, um soziales Lernen in SDG-Projekten zu verbessern; und b) die Operationalisierung von sozialen Lernprozessen kann die Qualität von Daten und Projektergebnissen von Projekten für nachhaltige Entwicklung erhöhen.

Diese Dissertation, ein kumulativer Ansatz, der fünf von Experten begutachtete wissenschaftliche Zeitschriftenartikel integriert, ist wie folgt strukturiert:

Kapitel 1, die Einführung, umreißt das Forschungsproblem, das in das Paradigma der nachhaltigen Entwicklung eingebettet ist, sowie die Notwendigkeit und Herausforderungen des sozialen Lernprozesses.

In **Kapitel 2** wird der theoretische Rahmen in Bezug auf die Konzeptionen des sozialen Lernens und die Bildungstheorien näher erläutert, um die theoretische Grundlage für diese Dissertation zu schaffen. Der Ansatz der Dissertation bezieht sich auf das Konzept der Kritischen Bildung, eingebettet in ein konstruktivistisches Paradigma, das die Bedeutung der Reflexion einer Praxis bewusster, fragender und zukunftsorientierter Bildung analysiert.

Kapitel 3 bietet das Forschungsdesign. Diese Arbeit wurde in drei komplementären methodischen Phasen abgeschlossen. Die Feldforschung wurde in drei internationale Forschungsprojekte eingebettet. Diese Forschungsprojekte boten ein fruchtbares Umfeld, um die Forschungsfragen zu untersuchen und anzusprechen, da sie in verschiedenen ländlichen Gemeinschaften nachhaltige Entwicklungsstrategien für nicht nur die Ernährungssicherheit (SDG 2), sondern auch die Anpassung an den Klimawandel (SDG 13) anstrebten. Die insgesamt acht Studienfälle basierten in vulnerablen Kleinbauerngemeinschaften zunächst in Südamerika (Brasilien) (4 Fälle) und in Subsahara-Afrika (Tansania) (4 Fälle).

Der Abschnitt „Ergebnisse“ (**Kapitel 4**) ist der Hauptteil dieser Dissertation und umfasst vier von Experten begutachtete Zeitschriftenartikel. Unterabschnitt 4.1 bietet eine konzeptionelle Grundlage für soziales Lernen (Publikation 1 und 2). Unterabschnitt 4.2 bietet eine funktionierende Basis für soziales Lernen (Publikation 3). Unterabschnitt 4.3 bringt eine abschließende Bewertung als ergänzenden Prozess für soziales Lernen (Publikation 4).

Der erste und der zweite Artikel liefern die konzeptionelle Grundlage für alle weiteren in dieser Dissertation vorgestellten Studien. Anhand von Fallstudien in gefährdeten brasilianischen Gemeinden wurden psychologische und pädagogische Aspekte des sozialen Lernens identifiziert, um gemeinschaftsbasierte Strategien zu entwickeln. Vier Studienfälle wurden mit strukturierten und halbstrukturierten Interviews durchgeführt (n = 50).

Basierend auf den Ergebnissen der ersten und der zweiten Arbeit, konzentrieren sich die dritte und vierte Arbeit auf die Gestaltung und Operationalisierung von Bildungswerkzeugen zur Steigerung des sozialen Lernens von Projekten (Partizipation und Eigentümerschaft). Hier werden Fallstudien in Tansania vorgestellt, in denen ein innovatives pädagogisches Instrument entwickelt wurde, um die Stimmen der Bevölkerung bei der Schaffung lokaler Lösungen für Ernährungsunsicherheit mit insgesamt 270 Bewohnern zu unterstützen. Dieses pädagogische Werkzeug wurde 16 Mal in Bezug auf Akzeptanz, Anwendbarkeit und Reproduzierbarkeit in vier abgelegenen ländlichen Gemeinden erstellt, angewendet und getestet.

Der Artikel 4 analysiert die möglichen Auswirkungen einer nachhaltigen Strategie, die gemeinschaftsbasierte und forschungsbasierte Bewertungen als komplementären Prozess des sozialen Lernens integriert. Ein Studienfall mit ScalA-Tools wurde in ländlichen Gemeinden in Tansania entwickelt. **Kapitel 5** ist eine Zusammenfassung der Ergebnisse. Jeder Unterabschnitt liefert Antworten auf eine der Forschungsfragen auf der Grundlage der theoretischen und empirischen Daten, die in den fünf Veröffentlichungen erstellt wurden. Durch die Forschungsergebnisse kann die Hypothese nicht widerlegt werden.

Kapitel 6 enthält Schlussfolgerungen und hebt die Kernaussagen des in dieser Dissertation entwickelten Wissens hervor. Darüber hinaus werden in diesem Abschnitt die Einschränkungen und Aspekte aufgeführt, die weiter untersucht werden müssen.

Die wichtigsten Schlussfolgerungen sind wie folgt zusammengefasst: Der konstruktivistische pädagogische Rahmen ist geeignet, ein pädagogisches Instrument zur Verbesserung des sozialen Lernens in SDG-Projekten zu operationalisieren. Dieser Befund trägt nicht nur zu einem besseren Verständnis von Mechanismen bei, die soziales Lernen fördern, sondern stellt auch einen Fortschritt in den theoretischen Verbindungen zwischen sozialem Lernen und den Theorien von Habermas und Freire dar. Der soziale Lernprozess ist nach drei Hauptschritten möglich. Der primäre pädagogische Schritt für soziale Lernprozesse in SDG-Projekten besteht darin, dieses gemeinschaftliche Wissen und mentale Systeme genau zu identifizieren und zu erkennen (Artikel 1 und 2). Der zweite pädagogische Schritt betrifft dann die Entwicklung lokaler Lösungen durch die Mitglieder der Gemeinschaft auf der Grundlage eines kritischen Verständnisses ihrer eigenen Lebensbedingungen (Kodifikations- und Dekodifizierungsprozess, der auf der Transformation von mentalen Schemata basiert). Daher kann durch eine Prozess-Bewusstmachung eine Umgestaltung der Zukunft der Gemeinschaft geschaffen werden, die möglicherweise das Gefühl der Eigentümerschaft erhöht (Publikation 3). Ein dritter Schritt zur Förderung von SDG-Projekten, die soziales Lernen fördern, ist der Vergleich der Wahrnehmungen der Gemeinschaft (community) und der Forschungsexperten zu SDG-Strategien. Dies sind Ergänzungen, um mögliche Auswirkungen von Projektstrategien zu bewerten, die den deliberativen Charakter des sozialen Lernens verbessern (Publikation 4). Diese drei Schritte fördern den Multi-Akteurs-Dialog für die Entwicklung von Strategien auf Gemeinschaftsebene und bereichern das Verständnis für komplexe Situationen, mit denen die nachhaltigen Entwicklungsprojekte zu tun haben.



List of Publications

Bonatti, M., D'Agostini, L., Sieber, S., Lana, M., Vasconcelos, A., Silva-Rosa, T., Schlindwein, S. (2018). Social representations of climate change and climate adaptation plans in southern Brazil: challenges of genuine participation. *Urban climate* (Accepted)
(Impact factor 2.9)

Bonatti, M., Sieber, S., Schlindwein, S.L., Lana, M.A., de Vasconcelos, A.C., Gentile, E., Boulanger, J.P., Plencovich, M.C. and Malheiros, T.F., (2016). Climate vulnerability and contrasting climate perceptions as an element for the development of community adaptation strategies: Case studies in Southern Brazil. *Land Use Policy*, 58, pp.114-122.
DOI: 10.1016/j.landusepol.2016.06.033
(Impact factor 3.5)

Bonatti, M., Schlindwein, I., Bundala, N., Lana, M., Sieber, S., Rybak., C. (2017). Innovative educational tools development for food security: engaging community voices in Tanzania. *Futures*.
DOI: 10.1016/j.futures.2017.11.008
(Impact factor 1.9)

Bonatti, M., Homem, L. H., Graef, F., Mbwana, H. A., Rybak, C., Lana, M., Sieber, S. (2017). Social organization, constraints and opportunities for kitchen garden implementation: ScalA and ScalA-FS assessment tools in Morogoro and Dodoma, Tanzania. *Food Security*, 9(6), 1299–1308.
DOI: 10.1007/s12571-017-0726-7
(Impact factor 2.2)

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Further Peer-Reviewed Articles Published Relevant to the PhD Topic

- Borba, J., **Bonatti, M.**, Sieber, S., Müller, K. (2018). Theatre Methods for Food Security and Sovereignty: a Brazilian scenario in the semi-arid. *Journal of Rural studies*. (Accepted)
- Bonatti, M.**, Borba, J., Lohr, K., Sieber, S., Bundala, N., Rybak, C., Müller, K. (2018). Contextual factors of nutrition insecurity in remote rural communities in Tanzania: integrating community perceptions for social learning. *Journal of Rural studies*. (Submitted)
- Schlindwein, S. L., Eulenstein, F., Lana, M., Sieber, S., Boulanger, J. P., Guevara, E., **Bonatti, M.** (2015). What can be learned about the adaptation process of farming systems to climate dynamics using crop models? *Sustainable Agriculture Research*, 4(4), 122. DOI: 10.5539/ ISSN 1927-050X
- Rosa, T., **Bonatti, M.**, Vanini, A., Zuffo, C. (2014). Vulnerability and Climate Change perceptions: a case study in Brazilian biomes. *Environment and Pollution Journal, Environment and Pollution*; Vol. 3, No. 1. DOI: 2014 ISSN 1927-0909
- Bonatti, M.**, Schlindwein, S., Sieber, S., Vasconcelos, A. C., D'Agostini L. R. (2013). Social Organization and Agricultural Strategies to Face Climate Variability: a Case Study in Guaraciaba, South Brazil. *Sustainable Agriculture Research*, 2013, v.2, p. 118–125, 2013. DOI:10.5539 ISSN 118 5539
- Vasconcelos, A. C. F., **Bonatti, M.**, Schlindwein, S. L., D'Agostini, L. R., Homem, L. R., & Nelson, R. (2013). Landraces as an adaptation strategy to climate change for smallholders in Santa Catarina, Southern Brazil. *Land use policy*, 34, 250–254. DOI: 10.1016/j.landusepol.2013.03.017



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Abbreviations and Acronyms

BMU	Bundesministerium für Umwelt, Naturschutz und nukleare Sicherheit - German Federal Ministry of the Environment, Nature Conservation and Nuclear Safety
BMBF	Bundesministerium für Bildung und Forschung - German Federal Ministry of Education
BML	Bundesministerium für Ernährung und Landwirtschaft - German Federal Ministry of Food and Agriculture
CLARIS LPB	Hydroclimate and Society in La Plata Basin - EU Collaborative Project
FAO	Food and Agriculture Organization
GlobeE	BMBF funding initiative (Securing the Global Food Supply)
MDGs	Millennium Development Goals
NL	The Netherlands
Scala tool	Scaling up Assessment Tool
Scale-N	Scaling-Up Nutrition project
SDGs	Sustainable Development Goals
SDG 1	Sustainable Development Goal 1: No poverty
SDG 2	Sustainable Development Goal 2: Zero hunger
SDG 13	Sustainable Development Goal 13: Climate Action
SL	Social Learning
SUA	Sokoine University of Agriculture of Tanzania
Trans-Sec	Innovating Strategies to safeguard Food Security project
UN	United Nations
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNGA	United Nations General Assembly
WWF	World Wildlife Fund

1

Introduction

With the human population expected to reach 9 billion by 2050, definitions and mechanisms to achieve sustainable development must be revised to target stable functioning of Earth's systems (Robert et al., 2002, Griggs et al., 2013, Makkar and Vasishta, 2017). Continuing population growth means that the global demand for food will increase for at least another 40 years (Godfray et al., 2010). Hence, competition for land, water, and energy will also increase, ultimately affecting human ability to produce food (Ghanem, 2010; Oskamp, 2000), creating a challenging future (Evans, 2009). The effects of climate change are a further threat. Future impacts will be highest for the populations already living in hunger (FAO, 2017).

Over the last two decades, these issues raised on the public and the private sector agendas due to their importance for societal security (Claire et al., 1996, Jörby, 2002, Swanson and Pintér, 2007). “Transforming Our World: The 2030 Agenda for Sustainable Development” (2030 Agenda) is an intergovernmental agreement that is meant to guide global development efforts over 15 years, from 2016 through 2030. The 2030 Agenda consists of 17 Sustainable Development Goals (SDGs) and 169 underlying targets (UN, 2015 2030 Agenda). The Sustainable Development Goals (SDGs) adopted by the United Nations General Assembly (UNGA) in September 2015, replace the Millennium Development Goals (MDGs), which held sway from 2000 until 2015 (UN, 2015). The SDGs are designed to build on the MDGs and to complete what was not achieved (2030 Agenda, UN General Assembly, 2012).

Sustainable development goals (SDGs) and its indicators (Annex 1) are intrinsically connected (Nilsson, 2017, Nilsson and Persson, 2017, Sachs, 2012). No poverty (SDG1) and Zero hunger (SDG2) are addressed by United Nations as priorities (McGuire, 2015), especially in Sub-Saharan Africa, where 25% of the population is malnourished and particularly in rural areas (McGuire, 2015, FAO, 2015, FAO, 2017). Poverty, food and nutrition security remain a major challenge for sustainable agriculture development. Further, climate action (SDG13) is fundamentally important for food security and poverty alleviation, especially in developing countries. Poverty, hunger, and climate change need to be jointly tackled because of their interdependency in terms of their interconnected structural causes (Parr, 2014, Steffen and Smith, 2013, Adger, 2003, Adger et al., 2006).

Since the Brundtland Commission first defined sustainable development, numerous scholars and practitioners have articulated and promoted their own alternative definitions (Kates et al. 2005); in parallel, the methods to create sustainable development strategies are heavily debated (Holden et al., 2017, Hopwood

et al., 2005). To target these SDGs implementation challenges, complex solutions must be created (Holden et al., 2017, Steffen & Smith, 2013). Lessons learned from the non-accomplishment modern agriculture goals and propositions (such as world hunger decrease and developing countries smallholders' prosperity increase) reveals that technical-economic approaches and technical-instrumental solutions for development are not sufficient (De los Rios et al., 2016). It emphasizes the important role of individual behavior as well as the contexts in which it occurs (Lang, T., 2010). In addition, this reveals the necessary to enrich the connections between vulnerable communities' prosperity and other concepts, such as social capital, collective action, innovations, and ownership (De los Rios et al., 2016). In light of this, many schools of participatory approaches and community learning have been developed (Colins and Ison, 2009).

Due to the holistic, diverse, and distinctive nature of substantiality issues (Steffen and Smith, 2013, Grochowska, 2014), it is crucial to develop new knowledge sources and learning forms that can integrate social and environmental values (Curry and Kirwan, 2014, Pretty, 2006).

1.1 Research background: sustainable development and the needs of social learning

Sustainable development requires the participation of diverse stakeholders with diverse perspectives, as well as the ideal of reconciling different, if not opposing, values and goals in order to create a new synthesis and global challenges solutions (Kates et al., 2005, De los Rios et al., 2016). The subsequent coordination of mutual actions to achieve multiple values both synergistically and simultaneously is critical (Adger, 2006, Rosa et al., 2013).

According to Friedmann (1993), "common actions" occurs through learning and planning in a community by retaining the memory and continuity of actions to carry them out through dialog, teamwork, projects and other means as a result of the logic of collective action. As pointed out by Crozier (1990), collective action is not a natural and spontaneous human interaction, nor is it a logical consequence of the problems to be solved. For this author, one's intentions, goals, and historical consciousness do not provide the success of one's projects as much as the media that is used (mediation between the "ends" and pursuing the "means"). Promoting people engagement, methodologies have been trying to build collective actions that facilitate social transformation (Berkes, 2002, Kim, 2014, Stringer et al., 2006).

Social learning is increasingly a normative goal in natural resource management (Parson and Clark, 1995, Diduck et al., 2005, Keen et al., 2005, Reed et al., 2010). It is because social learning offers a conceptual approach for problematic situations where interdependencies make it difficult to agree on the boundaries of an issue or how it will be represented and communicated to others (Collins and Ison, 2009).

Social learning is a fundamental shift in how people work, using more humanizing tools while accelerating individual and collective achievements (Bingham and Conner, 2010). It is linked to previous shifts toward adaptive management, participatory processes, and stakeholder engagement as a means to cope with complexity and the resultant uncertainty that managers face (Holling 1978, Walters 1986, Stringer

et al., 2006). The planning of interventions for community development tends to be more effective and sustainable when built on self-organizing tendencies and learning processes that seek to encourage people to act collaboratively (De los Rios et al., 2016, Reed et al., 2010).

Despite remarkable theoretical advances on participatory approaches (Chambers, 1994, Fals Borda, 1998, Rahman, 1993), a lack of readily applicable educational tools for community-based strategy development still remains, especially concerning social learning (Garmendia and Stagl, 2010, Kim, 2014) with respect to food security and climate change in the context of vulnerable rural zones. So far, only a few case studies (see Scholz, 2016) analyze the added value of integrating pedagogical concepts of social learning and implementing educational tools to create sustainable development strategies (Scholz et al., 2014) at the community level.

Projects seeking to implement SDGs are challenging and present complex settings to implement social learning processes, which are built on different paradigmatic and epistemological assumptions (as discussed in chapter 2). However, these settings can offer managers and policy-makers alternatives and complementary possibilities to develop new and more effective structures to knowledge mediation (Muro and Jeffrey, 2008, Kim, 2014). Social learning is gaining recognition as potential governance or coordination mechanism in complex natural resource problematics, but its underlying assumptions and mechanisms to enhance social learning need to be better understood (Kim, 2014, Collins and Ison, 2009).

In this context, the overall objective of this dissertation is to develop educational tools and improve pedagogical processes to enhance social learning, especially to pursue SDGs 2 and 13 in vulnerable rural communities.

1.2 Research objectives

This dissertation project narrows the gap between empirical knowledge about integrating pedagogical processes and implementing educational tools to create sustainable development strategies at the community level. At its core, the overall objective is to develop educational tools and improve pedagogical processes that enhance social learning, especially in realizing SDGs 2 and 13. This objective is operationalized through three research questions:

- a) What are, and how to identify, the pedagogical aspects of social learning to develop community-based strategies?;
- b) How to operationalize them in an educational tool designed to enhance social learning?; and
- c) How to analyze the potential effects of the strategies integrating community-based and research expert-based assessments?

The complementary hypotheses guiding this work are:

- a) A constructivist pedagogical frame can be operationalized in an educational tool to enhance social learning in sustainable development projects; and
- b) Operationalizing social learning processes increase the quality of data and output of sustainable development projects.

To verify the hypothesis, three objectives are defined:

- a) To identify psychological and pedagogical aspects of social learning to develop community-based SDGs strategies;
- b) To design and test educational tools at the community level (operationalizing psychological and pedagogical aspects of social learning from (a); and
- c) To analyze possible effects of the strategies integrating community-based and research expert-based assessments.

1.3 Structure and organization

This cumulative dissertation integrates four peer-reviewed scientific articles and is structured as follows:

Chapter 1 introduce and outlines the research problem embedded in the sustainable development paradigm, the needs and challenges of social learning, participation and ownership in research projects, as well as the relevance of this study.

Chapter 2 develops the theoretical frame concerning social learning conceptualization and education theories in further detail, as well as provides the theoretical foundation of this dissertation. The approach adopted in the dissertation is related to the concept of Critical Education. It is embedded in a constructivist paradigm that analyses the importance of the reflection of a practice of conscious, questioning, and forward-thinking education. The social learning theory is intrinsically related to Critical Education. In this approach, the theories of Paulo Freire and Jürgen Habermas, based on a dialogical process, Conscientization, communicative action, and empowerment, are outlined.

Chapter 3 provides the research design and methodology used to explore the hypotheses. This work was done in three complementary methodological phases. Each phase answered one of the research questions and generated at least one publication.

The Results section (chapter 4) comprises four peer-reviewed journal articles. Therefore, each subsection presents at least one publication addressing one research question. Subsection 4.1 aims to conceptually understand psychological aspects of social learning elements to develop community-based strategies. The first and second article provides the conceptual basis for all subsequent studies presented in this dissertation. This article proposed an “Adaptation learning process framework” that emerges from the description of contrasts in perceptions and cognitions observed between the study cases developed.

Subsection 4.2 focuses on the design and testing of educational tools at the community level. The third article present innovative educational activities developed to engage community voices in order to understand food insecurity and to create local solutions based on the framework presented in the previous article (Subsection 4.1). The educational tools applied served to raise community voices and to promote consciousness about community problems. The solutions created by the communities using the educational tool were then adopted in the research project, thus indicating increased participation and ownership, resulting in social learning.

Subsection 4.3, the fourth article, assesses the creation and effects of strategies combining the assessments of both community members and experts through an investigation of the opportunities and constraints of implementing a kitchen gardens policy in rural Tanzania. Several specific aspects, challenges, and likely bottlenecks related to implementation, including the feasibility and requirements, were indicated. These findings highlight the importance of an integrative assessment, as part of social learning process, combining the voices of researchers and the community to identify the potential effects of a strategy before it is implemented.

Chapter 5 is a synthesis of results. Each subsection provides answers to one of the research questions based on the theoretical and empiric data produced in the five publications.

Chapter 6 provides conclusions, highlighting the key messages of the knowledge developed in this dissertation, while also noting its limits and indicating which aspects need to be addressed in further research.

2

Theoretical Frame

This chapter explores the theoretical framework concerning social learning conceptualization and education theories in further detail, providing the theoretical foundation of this dissertation (Figure 1). With it, the logic and connections between assumptions and some of the main references are established. The idea is to represent the rationality and theoretical argumentation of the context, problem, and approach in this research.

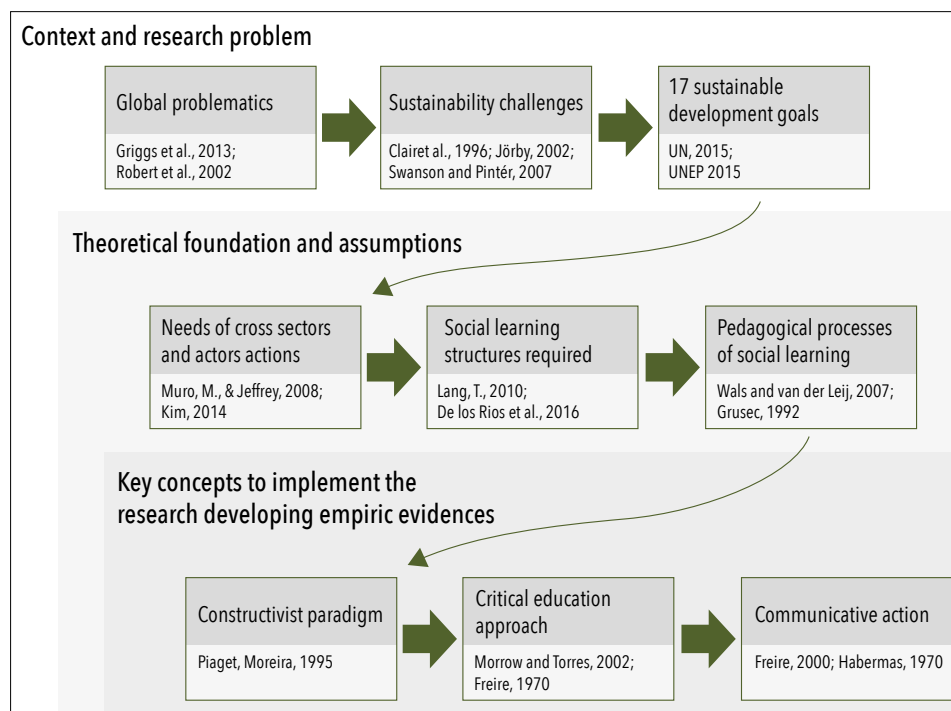


Figure 1: Theoretical design concerning social learning conceptualization and education theories adopted. Source: Michelle Bonatti

2.1 Social learning

Social learning is a long-established theory that is influenced by different theoretical traditions (Wals, 2007, Blackmore, 2007, Collins and Ison, 2009). Its origins lie mainly in psychology (stimulus-response) around the 1940s, although many disciplines adopt the term and it is mainly influenced by education

sciences (Cowan et al., 1969). Specifically, social learning theory became disseminated through the separate attempts of Sears (1957, 1963) and Bandura (1977) to combine psychoanalytic and stimulus-response learning theory into an explanation of human behavior (Grusec, 1992, Salkind, 2004). Bandura drove features of the approach, emphasizing instead cognitive and information-processing capacities that mediate social behavior promoting learning (Bandura, 1977). Sears and Bandura's theories were intended to be a general framework for understanding human behavior and its developmental aspects (Grusec, 1992). This first school of social learning points out that individual learning takes place in a social context and, hence, is influenced by social norms and image (e.g., Imitating role models) (Bandura 1977).

Bandura's social learning theory emphasizes the importance of observing and modeling the behaviors, attitudes, and emotional reactions in contact with groups. This theory supposes that most human behavior is learned observationally through modeling in interactions (Bandura, 1977). Therefore, initially social learning theory explained human behavior regarding continuous reciprocal interactions between cognitive, behavioral, and environmental influences (Mobley et al., 2007).

Since the 1990s, a second school of thought has simultaneously arisen in multiple research areas (Reed et al., 2010), where social learning is increasingly cited as an essential component of sustainable natural resource management (Reed et al., 2010, Pahl-Wostl, 2006) and for the promotion of desirable behavioral change (Colins and Ison, 2009). It originates from concepts of organizational learning and organizational development (Argyris and Schön 1996, Senge 1990), systems thinking (Ison and Watson, 2007, Colins and Ison, 2009), and socioecology (Pahl-Wostl, 2006, Pahl-Wostl, 2002) (Tab. 1).

...1950-1980s	1990s	2000s	2010...
...How do we learn in a group?	How do we learn as an organization?	How do we learn for sustainability?	Creation of institutional frames...
Sears (1957, 1963) and Bandura (1977) to combine psychoanalytic and stimulus-response learning theory into an explanation of human behavior	Social learning adopted in organizational learning and organizational development (Argyris and Schön 1996, Senge 1990), systems thinking (Colins and Ison, 2009), and Socioecology (Pahl-Wostl, 2006, 2002)	Simultaneously arisen in multiple research areas, where social learning is increasingly cited as an essential component of sustainable natural resource management (Reed et al., 2010, Pahl-Wostl, 2006)	E.g., UNESCO Chair in Social Learning and Sustainable Development established in 2010 at the University of Wageningen (NL)

Table 1: Evolution of the Social Learning concept and its guiding questions. Source: Michelle Bonatti

The term social learning arose in response to a growing recognition that learning for social transformation occurs through situated and collective engagement with others (e.g., a form of praxis) (Reed et al., 2010). Therefore, social learning can be conceptualized as a process of social change in which people learn from each other in ways that can benefit broader social-ecological systems. Based in collaborative pro-

cesses, it develops new relational capacities and rationalities between social agents, in the form of learning how to integrate others' roles and knowledge differently (Pahl-Wostl et al., 2008, Reed, et al., 2010). Collins and Ison (2009) interpret social learning as one or more of the following processes:

- The convergence of goals (more usefully expressed as agreement about purpose), criteria and knowledge leading to awareness of mutual expectations and the building of relational capitals.
- The process of co-creation of knowledge, which provides insight into the causes of, and the means required to transform, a situation. Thus, social learning is an integral part of the make-up of concerted action.
- The change of behaviors and actions resulting from understanding something through action ('knowing') and leading to concerted collective action.

While rethinking and questioning the participation definitions, social learning proposes an active social engagement that emphasizes the dynamic interaction between people and the environment in the construction of meaning and identity (Muro and Jeffrey 2008, Reed et al., 2010). However, much of the existing literature rarely include conceptual advancements in the education and psychology (Fazey et al., 2007), and there remains little consensus or clarity over the conceptual basis of social learning (Wals and Van der Leij, 2007, Grusec, 1992). A research gap remains concerning the connections between the second school of social learning with pedagogical and psychological concepts to clarify the conceptual and operational basis of social learning (Kristjanson et al., 2014). At the same time, few empirical studies try to do this. This dissertation proposes to do so.

2.2 Critical education embed in the constructivism paradigm as an approach for social learning development

To clarify the pedagogical conceptual basis of social learning, this dissertation proposes the development of educational tools based on critical education embedded in the constructivism paradigm. It is based in the constructivism school that originates mainly from Piaget's theory of mental development, which talks about learning as a process of understanding, processing, and storing information in a meaningful relationship with the constructed reality (Moreira, 2000, Inhelder and Piaget, 1958). In this case, the learner is an active agent in their education and not merely receiver of information.

For Moreira (2000), cognition refers to the act of knowing, the attribution of meaning to concepts, events, and objects in the real world - constructivism means that construction of ideas and previous experiences produces knowledge. He (2000) notes, one frequent error is that learning by discovery is confused as constructivism; another is the consideration of practical experience as the application of constructivist methods. The author points out that, first, constructivism is not a method, but a paradigm. Without the conceptual structure intertwined with the significant universe of the learner and their interaction with the other, the construction of knowledge is not possible (Moreira, 2000, Moreira, 2002). Learning is a

non-arbitrary and non-literal process occurring with the organization and integration of concepts and ideas that form a cognitive structure based on experimentation, critical and reflection exercises, as well as interaction with others (Inhelder and Piaget, 1958, Moreira 2002).

Critical Education, embedded in a constructivist paradigm, analyses the importance of the reflection of a practice of conscious, questioning, and forward-thinking education for development (Habermas, 1981, Freire 1970, Freire, 2014, Morrow and Torres, 2002). From this perspective, it is essential that the broad education proposes a process where the people involved learn to deal with what is learned (metacognition and critical understanding). In addition, it proposes to consider the unity of person as well as the resolution of unforeseen collective problems, such as the dynamics of climate consequences and the food insecurity situation.

Considering that social learning is centered on critical understanding and capacity development as a prerequisite of the social transformation of a critical situation (food security and climate change situations), the perspective adopted in this dissertation is related to the concept of critical education. Thus, inspired by Freire's critical education (1970, 2000), the process of developing community-based strategies can be generated from, and in a critical collective reading of, community problems in order to transcend the conditions that lead to states of vulnerability.

2.3 Pedagogy of oppressed and communicative action: Habermas and Freire contributions

The incorporation of the theories of Paulo Freire and Jürgen Habermas¹ into adult education theory contributed to the development of concepts such as transformative action and communication (Morrow and Torres, 2002, Freire, 2000, Habermas, 1981) critical consciousness (*conscientization*), critical education (Morrow and Torres, 2002, Freire, 2000), and transformative learning (Pietrykowski, 1996, Mezirow, 1994, Freire, 2000). Due to their proposed operationalization of development processes based on consistent theoretical assumptions and work to generate interventions based in human development, these contributions generated a lively and spirited debate within the field of adult and critical education (Leeuwis, 2000).

In this dissertation, the debate is extended to include an analysis of the role that the contributions of Freire and Habermas play in the development of educational tools that facilitate the social learning processes needed to realize SDGs 2 and 13.

Based on Habermas (1970), learning may occur through two basic types of social interaction:

- Information transmission, i.e., simple learning of new facts through social interaction; and
- Deliberation (Newig et al., 2010), which refers to a genuine exchange of ideas and arguments during which ideas and perceptions change through persuasion.

¹ Paulo Freire (Brazilian) and Jürgen Habermas (German) made a large contribution to the understanding of the relationship of social theory, politics, education, and educational practice in the 20th century (Morrow and Torres, 2002). This dissertation focuses on some of their main concepts in order to facilitate the understanding of Freire and Habermas while keeping the connection with the research objective.

Rist et al. (2007) build on this, arguing that social learning require the creation or enhancement of social space for what Habermas (1970) calls “communicative action,” e.g., through new social movements and development of the collective initiative. In this way, social learning may lead to changes, not just in social networks but also wider societal and institutional structures. Therefore, this process must be more deliberative than either information transmission or knowledge transfer. Through the dialectical links between these elements, people and the environment are inseparable parts of a process of mutual constitution and adaptive evolution (Rist et al. 2007). Therefore, people are immersed in a mesh of elements-events, actively creating it.

The process of people negotiation, emancipatory communication, and creation of self-development paths is based on what Habermas called as communicative rationality (Habermas, 1981, Mezirow, 1991). Communicative rationality is distinct from instrumental and normative rationality. It is self-reflexive and open to a dialogue in which participants in an argument can learn from others and from themselves by reflecting upon their premises and thematizing aspects of their cultural background knowledge in order to question old suppositions (Otto and Fourie, 2009, Mezirow, 1991).

Communicative action is action based upon this deliberative process, where individuals interact and coordinate their action based upon agreed interpretations of their situation. By considering all functions of language, communicative action is distinguished from other forms of action, such as instrumental action, which is a goal-oriented behavior primarily addressed in economics (Habermas, 1981). Communicative action can reflect upon language used to express propositional truth, normative values, or subjective self-expression (Mezirow, 1991). In this process, social actors can negotiate their interpretation of problematics and explore possibilities to overcome it (Pahl-Wostl, 2002).

Freirean dialogical praxis and the Habermasian communicative action theories are seen as complementary (Morrow and Torres, 2002). Freirean “pedagogy of the oppressed,” propose the praxis of dialogical communication or intersubjective communication as crucial for development and education (Otto and Fourie, 2009, Freire, 2000). For both theorists, transformative actions can only occur if reflective and collective learning occurs in linguistically constructed settings where the normative dimensions of community development are raised and met in the collective action.

This dissertation is theoretically framed and empirically developed under the light of Freire and Habermas, which provide vital knowledge regarding the praxis of dialogical communication, communicative action, social transformation, and critical learning.

3

Research Design and Methods

In this section, first, the methodological structure of this dissertation is presented. Second, the projects where the study is embedded are described. The methods used in the study cases are only briefly described as they are presented in great detail in the publications (Chapter 4, Results).

3.1 Research design

The overall objective of this dissertation is to develop educational tools and improve pedagogical processes in order to enhance social learning, especially to pursue SDGs 2 and 13 in rural communities. To accomplish this goal, this work was based on concatenate research phases (Fig. 2). Each phase addresses one of the research questions and generated at least one publication. The first phase has a deductive character while the second and third were inductive.

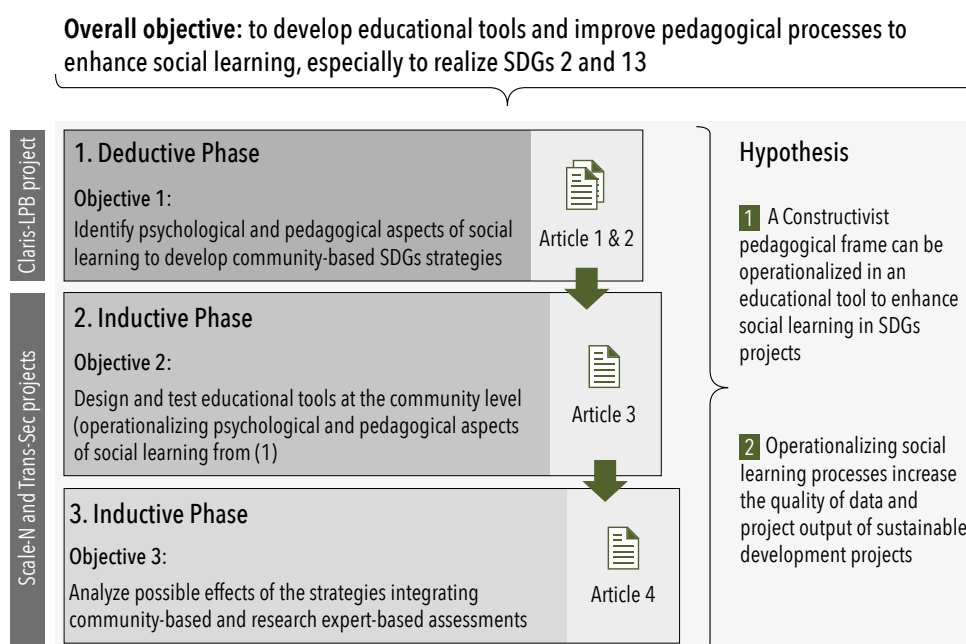


Figure 2: Research design linking the phases, objectives, methods and articles. Source: Michelle Bonatti

3.2 Research projects descriptions and methods

This dissertation consists of case studies carried on vulnerable smallholder's communities, first in South America (Brazil) and second in Sub-Sahara Africa (Tanzania). The field activities were embedded in three international research projects that are directly linked with SDGs. These research projects offered a fertile environment in which to investigate the research questions because the goal of each project is to create sustainable development strategies for food and nutrition security as well as climate change. The subsequent subsections briefly describe the specific objective of each of the three research projects. Methods used to address each research question are summarized in table 2.

Research question	Case study	Methods	Article
a) What are, and how to identify, the psychological aspects of social learning to develop community-based strategies?	Clarís LPB project, Brazil, 4 case studies	Semi-structured interviews and questionnaires (n= 50), Participant observation	1, 2
b) How to operationalize them in an educational tool designed to increase project social learning?	Scale-N and Trans-Sec projects, Tanzania, 4 case studies	Exploratory studies, questionnaires (n=663), 16 workshops with educational tools (n= 270)	3
c) How to analyze the potential effects of the strategies integrating community-based and research expert-based assessments?	Scale-N and Trans-Sec projects, Tanzania, 4 case studies	ScalA Assessment Tool (n=7), ScalA-FS Assessment Tool to food security (n=27), Participant observation	4

Table 2: Research questions, methods, and articles.

The specific regions of all applied studies in Tanzania and Brazil are described in chapter 4 (Results). The methods applied in the context of each of these three international research projects are also described in more detail in each publication.

3.2.1 CLARIS LPB PROJECT- Hydroclimate and Society in La Plata Basin

The Hydroclimate and Society in La Plata Basin - EU Collaborative Project (CLARIS LPB) aims to predict regional climate change impacts on La Plata Basin (LPB) in South America and to design adaptation strategies for land-use, agriculture, rural development, hydropower production, river transportation, water resources, and ecological systems in wetlands. In the context of this research project, the dissertation's objective, "a) Identify psychological and pedagogical aspects of social learning to develop community-based SDGs strategies," was investigated. The study cases are located in vulnerable smallholder communities in Brazil and have 50 participants.

Methodological procedures: Considering the subjective and psychosocial character of the research issue, a qualitative approach was adopted for this case study. The focus is on two aspects: (1) the perception of climate dynamics; and (2) the relationship between vulnerability and local climate dynamics, and development of sustainable strategies. Field data collection consisted of civil association meetings (participant observation and focus groups) and conducted semi-structured interviews with local actors (n=50) within four case studies (Bernard, 1988).

The semi-structured interviews were preceded by participant observation of meetings in the communitarian centers in order to allow the researchers to enhance the relevant and meaningful semi-structured interview protocol for the communities under study. Therefore, the aim of observing local civil association meetings was to gather information about the social structure of each study site. The adoption of this step was also necessary for an in-depth understanding of the social context in order to determine the methods of categorizing the assessed human populations, thus increasing the reliability and validity of the semi-structured protocol (LeCompte and Goetz, 1982). Following this procedure, semi-structured interviews and questionnaires were conducted with stakeholders from each of the research sites.

3.2.2 SCALE-N Project: Implementing potentials of nutrition-sensitive and diversified agriculture to increase food security

The main objective of Scale-N project is to safeguard food security and nutrition for the local populations in Tanzania by supporting the development of diversified and sustainable agriculture. Scale-N is financed by German Federal Ministry of Food and Agriculture (BMEL) and aims to ameliorate the critical food security situation and nutritional status of the rural poor in Tanzania (www.scale-n.org). In the context of this research project, it addresses the dissertation's second objective: Design and test educational tools at the community level; thus, researching the operationalization of psychological and pedagogical aspects of social learning.

Methodological procedures: The mixed methods approach combines qualitative and quantitative methods. This approach was adopted because it includes a suite of indicators that capture the multi-faceted nature of the food security concept (FAO, 2003). As Migotto (2007) points out, traditionally there is a division between objective quantitative methods and subjective-qualitative techniques for the measurement of poverty and food insecurity, particularly in the economics literature (Migotto, 2007, FAO, 2003). Researchers increasingly view these two types of measures and methods as complementary. In this case study, three methodological steps are combined.

The exploratory expeditions and participant observation (step 1, situation analysis) were conducted over 21 days. The aim was to gather information about the social structure of each study site. The adoption of this step was necessary for an in-depth understanding of both the social context and the discourse in the next step, the survey. Following this, the household survey was conducted, consisting of personal interaction with stakeholders from each research site.

The second wave of data was collected from selected households in the Dodoma and Morogoro regions of Tanzania. Face-to-face structured interviews with 663 households, using questionnaires, were conducted in order to collect demographic and socioeconomic information as well as other relevant information, focusing on understanding problems and food perceptions. The information documented during the survey was summarized in reports containing observations, recorded statements, tables, and calculations for each one of the four case studies in Tanzania.

The third step consisted of 16 workshops with a total of 270 participants. There were four workshops per village, each based on four categories: women, men, mixed, and children. To facilitate the interaction using pedagogical tools, the activities were conceptualized and designed as inspired by the Pedagogy of the Oppressed and Theater of the Oppressed, written by educator Paulo Freire (2000, 2014) and Augusto Boal (2003, 1979), and the elements of communicative action from Habermas (1970). This methodology is described in detail in article 3.

3.2.3 TRANS-SEC - Innovative Strategies to safeguard Food Security using Technology and Knowledge project

Trans-SEC is supported by the “Securing the Global Food Supply – GlobE” funding initiative and embedded in the “National Research Strategy BioEconomy 2030” framework program. The specific objective of Trans-SEC is to improve the food situation for the most-vulnerable rural poor population in Tanzania. It is designed to identify successful food securing upgrading strategies along local and regional food value chains, test and adjust them to site-specific, sustainable settings, and to tailor these concepts to be disseminated for national outreach (www.trans-sec.org). In the context of this research project, the investigation of the dissertation’s objective c) “analyze possible effects of the strategies integrating community-based and research expert-based assessments,” is carried out.

Methodological procedures: The research consists of three rounds of complementary methodological approaches. The first round was a qualitative approach of semi-structured interviews using Scaling up Assessment Tool (ScalA); a second round with a questionnaire survey, using Scaling up Assessment Tool for Food Security (ScalA-FS); and a third round with participant observation in workshops about food security in Dodoma and Morogoro villages.

The interviews were divided into two rounds: a) preliminary interviews (n=7) with experts to identify the main constraints to the implementation of kitchen gardens; and b) an in-depth assessment survey (n=29) to assess kitchen gardens as a food-securing strategy to be upgraded (UPS). A different ScalA tool was applied in each round. The first round of interviews was completed using the ScalA. The primary objective of ScalA is to allow for an *ex ante* assessment of the scaling-up potentials of good practices within the context of development projects. The questions explore aspects of health promotion, quality of life, and local social structures involved in kitchen garden practices in the project implementation. The second round of interviews was completed using the ScalA-FS (Graef et al., 2014, Graef et al., 2017), in

order to assess specific food-security aspects of the UPS. Applying the ScalA-FS tool, scientists were asked to assess implementation suitability and institutional requirements of kitchen gardens across the Dodoma and Morogoro regions.

The third methodological round was included as a complementary qualitative method to make possible a preliminary comparison between the expert's assessment and the perspective of local farmers. This consisted of participant observation in 16 workshops to discuss food security problems and local solutions in four villages (two in Morogoro, two in Dodoma) with a total of 205 local farmers.

4

Results

4.1 Psychological and pedagogical aspects of social learning to develop community-based strategies

Article 1:

Bonatti, M., D'Agostini, L., Sieber, S., Lana, M., Vasconcelos, A., Silva-Rosa, T., Schlindwein, S. (2018). Social representations of climate change and climate adaptation plans in southern Brazil: challenges of genuine participation. *Urban climate* (Accepted)

Article 2:

Bonatti, M., Sieber, S., Schlindwein, S.L., Lana, M.A., de Vasconcelos, A.C., Gentile, E., Boulanger, J.P., Plencovich, M.C. and Malheiros, T.F., (2016). Climate vulnerability and contrasting climate perceptions as an element for the development of community adaptation strategies: Case studies in Southern Brazil. *Land Use Policy*, 58, pp.114–122. DOI: 10.1016/j.landusepol.2016.06.033

4.2 Educational tool designed to increase project social learning

Article 3:

Bonatti, M., Schlindwein, I., Bundala, N., Lana, M., Sieber, S., Rybak., C. (2017). Innovative educational tools development for food security: engaging community voices in Tanzania. *Futures*. DOI: 10.1016/j.futures.2017.11.008

4.3 Potential effects of the strategies integrating community-based and research expert-based assessments

Article 4:

Bonatti, M., Homem, L. H., Graef, F., Mbwana, H. A., Rybak, C., Lana, M., Sieber, S. (2017). Social organization, constraints and opportunities for kitchen garden implementation: ScalA and ScalA-FS assessment tools in Morogoro and Dodoma, Tanzania. *Food Security*, 9(6), 1299–1308.

DOI: 10.1007/s12571-017-0726-7

5

Synthesis of Results

In this chapter, each subsection, based on the theoretical and empiric data produced in the five publications, addresses one of the research questions. Furthermore, the findings presented in this section are directly linked to the two complementary hypotheses: a) a constructivist pedagogical frame can be operationalized in an educational tool to enhance social learning in SDGs projects; and b) operationalizing social learning processes can increase the quality of data and project output of sustainable development projects. Through the research findings, both hypotheses could not be rejected.

5.1 What are, and how to (empirically) identify, pedagogical aspects of social learning to develop community-based strategies?

In article 1 and 2, regarding the interviews and questionnaires (n=50) with vulnerable populations, the interpretation of results indicates that social actors' climate perceptions and their evaluation about sustainable strategies can vary widely. However, it was not possible to understand the perception of the actors investigated merely by reducing it to a discursive content, without understanding their context and function in daily social interactions (article 1 and 2). The perception of vulnerable situations take place in a context where human mental schemes work adequately in a specific site (operating in a context where "think" on this way makes sense). Creating appropriate sustainable strategies at the community level depends on understanding and working on this set of mental schemes.

Therefore, from the findings of this research about pedagogical aspects, it was found that social learning process should be based on mental schemes and its transformation (article 1, 2, and 3). This is a potential base for the dialectical action regarding development of community-based strategies to SDGs 2 and 13.

Human mental schemes and its transformation can differ greatly depending upon the vulnerability context (article 2). Even living in a similar vulnerable situation, community members understand local problems very differently (article 2). It shows that vulnerable conditions are a compound of multiple factors that can be better identified through community knowledge. Therefore, the identification of local perceptions regarding problem situations and community interpretation are a fundamental pedagogical aspect of social learning process (articles 1 and 2).

From the second article, and as observed in the results of Grothmann and Patt (2005), social learning is not only an adaptive behavior, but it also requires changes in cognition (e.g., risk perceptions or mental schemes about feasible solutions), which are socially constructed and negotiated. This process can be interpreted as a constructed process of learning where individuals work on, and develop their own perceptions about problems and how to solve them.

Evidence from the case studies (article 1 and 2) show that the approach brought by constructivism fundamentally guides the process of social learning (hypothesis 1). As a broad principle, constructivism presupposes that knowledge is actively constructed by learners/people through interaction with physical phenomena and interpersonal exchanges and perceptions (Watts et al., 1997). As concisely distilled by Arib and Hesse (1986), people construct conceptual frameworks of social worlds in a complex feedback process, throughout which theoretical models and sensory input are assimilated and accommodated in a self-modifying sequence of prediction.

A second pedagogical aspect of social learning is that the formulation of SDGs strategies has to be congruent with community-system structure. The article 1 points out that the learning process with respect to developing sustainable strategies and, consequently, adapting a system of interest, like a community, must be strongly related to the dynamics of its structural changes. Therefore, social change goes beyond the individual and becomes situated and congruent within wider social units or communities of practice (Reed et al., 2010, Wenger, 2000).

According to Maturana and Varela (1987), systems (as communities), are determined by their structure, which means that all that takes place in them, or happens to them, is determined by their structure. The structure of a system (as a community), according to this understanding, refers to its components and the relations between them. Structural changes, in turn, are the result both of the system's internal structural dynamics and of the interactions of the system with its environment. However, the environment can only trigger changes that might be admitted by the structure of the system. If they are not, the system disintegrates. Therefore, an adapted system is a system whose structural changes are congruent with the structural changes of its environment. This understanding has far-reaching practical consequences for the social and economic transformation of a community. If we accept that a community is a determined structure system, it is the community, and only it, that determines the path of the adaptation process (its direction and its features). Therefore, successful community strategies require that the actions taken – for example, those regarding dissemination of information, education, and policy making – be congruent with the structure of the community and the way it operates (based on their previous perceptions and knowledge).

In this context, the second article proposed in its Figure 3 the “Adaptation learning process pre-steps framework.” It emerges from contrasts in perceptions/cognitions observed between the two study cases of article 2. The framework presented was developed considering that the main contrast between the studies case results is community perceptions of state of vulnerability and causes of local problems. Although both studied communities are strongly affected by climate events, their perception of climate effects is essentially different. The difference in perception arises mainly from the different context in which climate events acquire meaning, rather than any ability of assigning meaning to possible climate change.

Therefore, it is proposed that it is necessary to give significance to climate change (SDG 2) and food security (SDG 13) issues and strategies for the everyday life of community inhabitants. Identify and give significance to local issues considering local mental schemes is identified as the third central pedagogy element for social learning.

The idea is to create a framework (Figure 3 from the second article) that shows the learning process for the development of climate adaptation strategies, incorporating the perceptions of social actors, primarily local ones. This process must be strongly connected with local knowledge. Local knowledge is a collection of facts that relates to the entire system of concepts, beliefs, and perceptions held by people about the world around them. This includes the way people observe and measure their surroundings, how they solve problems, and how they validate new information. It includes the processes whereby knowledge is generated, stored, applied, and transmitted to others.

This social transformation and development of local knowledge characterizes an empowerment process that channels local social forces in the process of developing alternative adaptation strategies regarding collective knowledge (as depicted in Figure 3 of article 2). The way actors perceive reality, and how they give meaning and representations to this social reality, are personal and probably unrelated to those proposed by external agents, living in different social contexts. This gap in the understanding of a problem situation impacts the implementation of sustainable development project, thus risking the success of proposed innovations. The understanding of local perspective and integrating it into the development of a collective design of solutions is a key principle of social learning.

To understand the dynamics of establishing an adaptation strategy, motivational problems (Fig. 3) would stimulate reflections upon the conditions of vulnerability to climate change (or food insecurity). This idea is linked with what Freire (2000) calls the Decodification process. Decodification is a process whereby the people in a group begin to identify themselves in (local vulnerability) aspects of the situation (as climate change or food insecurity) until they are able to reflect critically upon various aspects of their situation, thus gaining understanding.

The second phase (Fig. 3) is a reflection about their Limit-situations (Freire, 2000). The Limit-situations are the historical structural problems, from which social actors cannot visualize possibilities of change and feasible transformative actions (Freire, 2000). According the author, these Limit-situations present themselves to men as difficulties historical determinants, overwhelming in the face of which there is no other choice, but to adapt (Freire, 2000). It is the perception of the limit-situation, and not the situation itself, that leads people to respond either with hopelessness or transformative actions. The third and fourth phases of Fig. 3, also based on Freire (2000), present the idea that the visualization of different and better living conditions, the unknown-viable, enables social actors to become aware of the power and capacity of acting with what they already have. Thus, the social actors could change their Limit-situations. The last phase of the figure, “designing strategies,” is consistent with the idea, based on demands identified and recognized as important, of outlining specific actions to change the state of vulnerability. This process of critical thinking moves from the whole to its parts and back to the whole, from the concrete (local needs) to the abstract (e.g., climate problems or nutritional needs) and back to the concrete actions. It can result in a new, critical perception of the existing vulnerable situation.

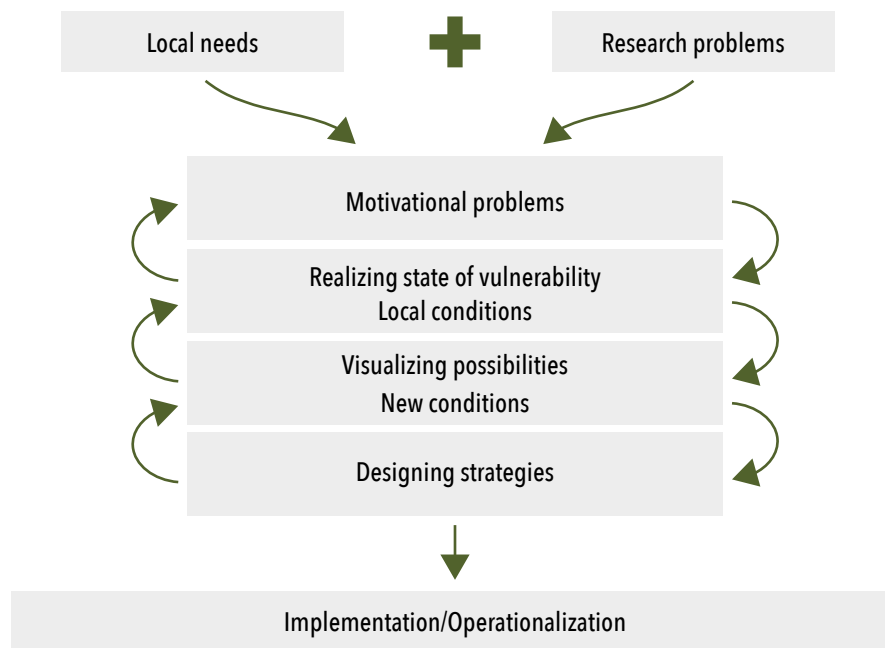


Figure 3: Adaptation learning process framework (original from the article 2).
Source: Bonatti et al., 2016

The application of this framework in a sustainable development project was done in the next research phase (to address the second research question: To design and test educational tools at the community level). This conceptual framework (Fig. 3) is operationalized in an educational tool to enhance social learning and tested in rural communities in Tanzania that were seeking to develop food security strategies. The results are presented in the subsequent section.

5.2 How to operationalize pedagogical aspects in an educational tool designed to enhance social learning increasing participation and ownership?

Findings from the first research phase indicate that the critical education approach should be appropriate for promoting the processes of community-based strategies development, based on self-organization, the internalization of information, the externalization of knowledge, and the interplay of externalization and internalization (Codification and Decodification), which can provides the basis of a co-evolution of cognition and social learning systems (article 1). To operationalize this process in real cases (SDGs projects), educational tools were created, based theoretically on the Freire and Habermas ideas and empirically on the findings of the previous articles (1 and 2).

The activities testing these educational tools involved a total of 270 participants across the four case studies in remote Tanzanian villages. The results show that community voices and local problem perceptions differed significantly between the case study regions, which had a strong impact on the resulting coping strategies and nutritional status. More than 70 local diverse strategies were identified by applying the educational tools (article 3).

The educational tool developed for the activities in Tanzania presents a structure with three levels: conceptual (phases), operational (steps), and methodological (methods) (Fig. 4 original from article 3). The concepts of Freire were organized through a structure with three conceptual phases: 1. Recognition of community knowledge and the significant universe; 2. Critical understanding of the current situation; and 3. Visualization of the future unknown.

Each phase proposes an operationalization of Freirean concepts (Codification, Meaningful universe/Themes/Community inner constraints (phases 1, 2), Limit-situations (phase 2), Unknown-viable (phase 3), Consientization (phases 1, 2, 3) through the six steps (in total) (Fig. 4). Further, each step contains a method, for example, the forum theatre was used to create a scene about the critical situation that the community faces (phase 2). Although this structure of conceptual phases and operational steps is fixed, the methods may vary according to the acceptability of the participants (for example, the theater could be replaced by a collective painting or human photo).

Throughout these six steps applied (Fig. 4), participants explored five local problems and proposed local solutions to resolve them. These five problems were defined by previous research through exploratory expeditions and the baseline survey of Scale-N project. The five local problems identified were: conflicts/land, water, diseases, money, and food. The data collected during the workshops made it possible to identify main community drivers (constraints/meaningful universe), contextual factors and bottom-up strategies using innovative educational tools.

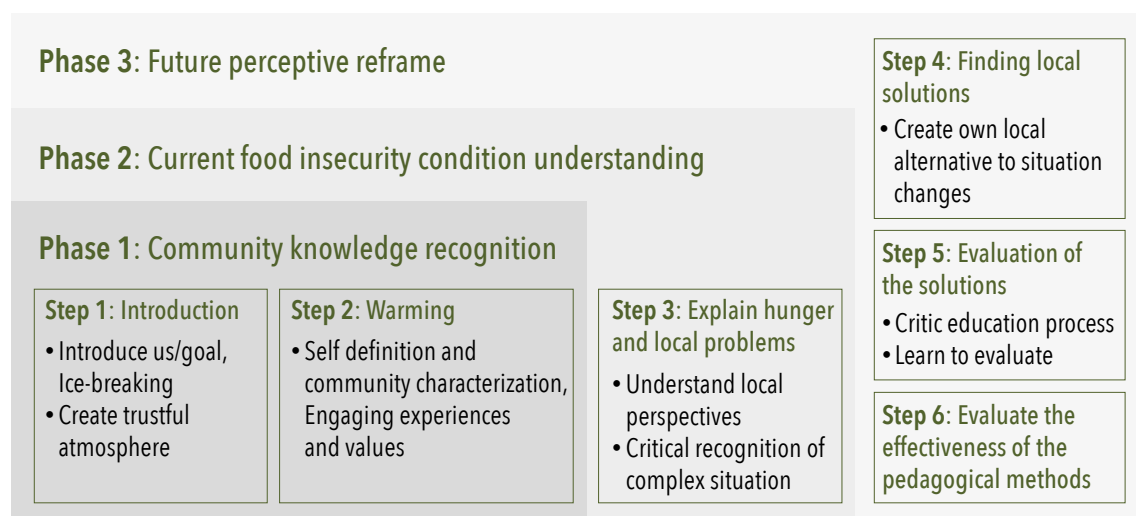


Figure 4: Phases and steps of the pedagogical tools design for social learning (original from article 3).
Source: Bonatti et al., 2017

In particular, implementing the educational tools is linked to two main Freire concepts: Limit-situations and Unknown-viable (Freire, 2000, Mejía, 2004). As conceptualized before, it is the perception of the Limit-situation, and not the situation itself, that leads people to respond passively, either with hopelessness or action (Freire, 2000). Such action, grounded in critical perception, is praxis. The creation of local strategies during the educational tools activities is linked with the Freire (2000) concepts, where the visualization of different and better living conditions, the Unknown-viable, enables social actors to

become aware of the power and capacity of acting with what they have. According Pässilä, et al. (2013), this process can be also interpreted as Futurizing (future potentials and seeing what does not yet exist). Thus, the social actors could change their Limit-situations. With the educational tool implemented, contextual factors, underlined causes, and possible solutions for food insecurity situation were explored in depth (article 3).

Interaction with the communities using this educational tool make it possible to identify the elements necessary for making “futuring” activities a fundamental step in the self-reflection of humans (Pereira and Funtowicz, 2013). More than just strategy adoption, the local actors are able to have ownership in the creation of strategies and learning in the integrative research project activities. Project ownership development is a process based on appropriation of knowledge and collective reflection about how to transform the community food insecurity situation. Høytrup and Elkjaer (2006) conclude that one of the most common ways to understand collective reflection is through an individualized perspective, wherein reflection is described as a cognitive individual learning process that takes place in social settings. It promotes understanding of the situation and its change can take place within the individuals involved (Reed et al., 2010).

Article 3 highlights that educational tools can also improve communication between the project members and the community. The educational tools implemented in this dissertation suited different forms of expression (verbal and non-verbal), modes of communication (theater, dance, dialogues), and even systems of thought (interconnected contextual factors of hunger). It might promote different forms of social learning about food insecurity conditions and help prevent project-community interactions from being reduced to a single model or conception regarding fixed representations (UNESCO, 2009) about food insecurity and climate change situations.

Techniques used in Theatre of Oppressed, such as the skits on hunger and conflict situations, made it possible to visualize and explore different community problems that are, in general, too delicate to incorporate in surveys (e.g., domestic violence, alcoholism, corruption, and beliefs in witchcraft). The tools of theatre should be considered for engaging villagers who are illiterate and do not speak the dominant language (e.g., 88% of rural Tanzanians), as theater can visually convey information and can help mitigate miscommunication that happens through translation. Being active, theatre can also hold the attention of those who are not culturally accustomed to listening to lectures or answering questions in more formal settings (Osnes, 2013).

The pedagogical structure to generate social settings of reflection is one of the key elements that the educational tool presented here brings. As proposed by Habermas (1981) and Freire (2000), is it fundamentally important in making viable a process of real Communicative action.

The educational tools developed in this dissertation generated a set and method that enhances social learning based in a constructivist pedagogical frame (hypothesis 1). The evaluation of effectiveness of the educational tools for social learning followed the criteria: (1) applicability; (2) acceptance; and (3) replicability, with the tools tested 16 times (comparing four different cases in Tanzania and with different genders and ages, as well as participant evaluation of the educational tools). The tools assessed acceptability in all 16 workshops applications. In the innovative pedagogical methods implementation

and acceptability evaluation, it was possible to get high participation in the activities and very positive evaluations in all sixteen workshops (article 3). More than 70 solutions for local problems related to food insecurity were created, and several contextual factors of food insecurity situations were discovered (article 3). Reasons and underlying causes of malnutrition status in the Tanzania study cases were in-depth explored; revealing that the adoption of food security strategies is intrinsically depends of contextual factors and sociocultural rationalities. Therefore, hypothesis 2 about social learning for increasing the quality of data and potential project outputs could not be rejected.

Finally, a feasible pedagogical structure is crucial for community-based development in SGD's project. However, evidently, although centuries of oppression and hunger cannot be remedied with a few years of projects, community confidence and consciences can be improved upon and strengthened (Osnes, 2013). By intentionally instigating a community discussion about such food security issues, women and men living in poverty can begin to see themselves as protagonists and not as passive recipients of a predetermined reality. Thus, they see themselves as actors capable of scripting their own lives and speaking out on their self-identified concerns through a process of social learning (Freire, 2000).

5.3 How to analyze the potential effects of the strategies integrating community-based and research expert-based assessments?

After developing educational tools for social learning at community level, creating community based strategies for SDG 2 and SDGs 13 (articles 1, 2, 3, and 4), it is necessary to complete an integrative assessment of potential effects. This assessment serves to finalize the process of co-creation of strategies by bringing expert and community knowledge together in the evaluation of impacts of the strategies. The findings from article 4 show that this assessment can be completed by applying the ScalA tools for research-expert evaluation and then proceeding with a community expert evaluation.

This process was completed within the Scale-N and Trans-Sec projects (article 4). The research consisted of three rounds of complementary methodological approaches. The first round was a qualitative approach consisting of semi-structured interviews using the ScalA tool. A second round involved a questionnaire survey, using ScalA-FS tool. The third round involved participant observation in workshops about food security with local farmers. The ScalA tools provide a range of statements that enable an overview of the structural situation that could facilitate promotion and scaling up of the strategy. In decision-making processes, scientists and stakeholders can use participatory *ex ante* assessment tools, like ScalA and ScalA-FS tools. These tools play a major role in guaranteeing the durability of kitchen gardens as a SDGs strategy. However, incorporating the perceptions of local farmers in the analysis is critical for the ultimate success of strategies in the community. Identifying, understanding and integrating the contrasting stakeholder's perceptions are key elements of social learning in order to converge perspectives and negotiate strategies (Rist et al., 2007, Wal et al., 2014).

This complementary phase where evaluations are compared helps to improve the process of social learning regarding the integration of different social actors. Sustainability impact assessment emphasizes the importance of different stakeholder levels (Gibson 2013; Bond et al., 2012) in the assessment

of solutions and in multi-level decision-making (Pope et al., 2004, Bond et al., 2012, Schindler et al., 2016). Webler et al. (1995) argue that participatory approaches in impact assessment supporting social learning processes need to aim to lead from uncoordinated individual actions to collective actions that reflect collective needs and understandings. *Ex ante* impact assessment combined with community perception supports participative planning and more sustainable collective action (Pahl-Wostl 2002; Pahl-Wostl 2006).

6

Conclusions

This dissertation contributes to the growth of empirical knowledge on operationalizing social learning processes in order to increase the quality of data and output in sustainable development projects. The methodological processes were applied to a series of three large research projects. The constructivist pedagogical frame used was appropriate to operationalize an educational tool that enhances social learning in SDGs projects. This finding is not just a contribution that improves the understanding of mechanisms that enhance social learning; it also represents an advance in the theoretical potentials links between social learning and the theories of Habermas and Freire. Table 3 presents an overview of key findings synthesizing the contributions of this dissertation regarding the proposed research questions and objectives.

6.1 Limitations and further research

This dissertation contributed to narrow the gap between education sciences and agricultural sciences to social learning for sustainable development. Therefore, this work is inherently transdisciplinary. As such, this work handles several challenges: defining the interconnection of authors and disciplines, as well as the subsequent application to “real world” problems, which involves interactions of actors across multiple levels. Research is facing the challenge of adopting transdisciplinary and being socially relevant while scientific rigorous. This work is an effort in this direction.

More robust results could be obtained by comparing outcomes in one project before and after the introduction of social learning models or, alternatively, by comparing similar projects with and without such social learning process.

It is important to highlight the ethical limits when comparing the results of this study with other cases where the educational tools were not applied. In the implementation of the educational tools designed in this dissertation project, although the participants compared their previous experiences with conventional methods (e.g, questionnaires), there was no comparison to other educational tools applied in other projects. Comparative studies to test and verify the findings of this dissertation are recommend.

Pedagogical aspects of social learning to develop community-based strategies to enhance social learning	Article
<ul style="list-style-type: none"> To understand the dynamics of establishing a strategy, the motivational problems (first phase, Fig. 3) would be a stimulus that triggers community reflections upon the conditions of vulnerability to climate change or food insecurity. Social learning is based on mental schemes. It also requires changes in cognition (e.g., risk perceptions or mental schemes about feasible solutions), which are socially constructed and negotiated. The identification of local perceptions about problem situation and community interpretation is crucial for mental schemes transformations (codification and decodification process). Community-based strategies must be compatible with the community system and its operation. 	1, 2
Operationalization in an educational tool designed to enhance social learning (participation and ownership)	
<ul style="list-style-type: none"> Implementing educational tools should be linked, in particular, to two Freire concepts: limit-situations and unknown-viable. Interaction with the communities using these educational tools made it possible to identify the necessary elements for making “futuring” activities as a fundamental step for humans’ self-reflection (Pereira & Funtowicz, 2013). More than strategy adoption, the local actors were able to have ownership in creating their own strategies. 	3
Potential effects of the strategies integrating community-based and research expert-based assessments	
<ul style="list-style-type: none"> <i>Ex ante</i> impact assessment combined with community perception supports participative planning and more sustainable collective action. This phase is fundamentally important because it shows differences between stakeholder perceptions; a key element of social learning. This process helps to improve of social learning with respect to the integration of different social actors and mutual negotiation. 	4

Table 3: Synthesis of key findings of the dissertation.

Regarding difficulties to implement social learning process, it is a challenge to ensure that the voices of participants in conversation are neither silenced nor substituted. Criticism about the Freire approach focuses on how to guarantee that critical reflection occurs and that the relevant aspects of community problems, such as hidden messages or assumptions, are identified and assessed (Mejía, 2004).

These challenges highlight the need to develop further research centered on the relationship between the educational tools application results and their impacts in further projects activities. In this way, also look for other bridges between different theoretical educational approaches for social learning (Festas, 2015) in sustainable development projects. The learning process is a continuous and long process that can be promoted and initiated with the educational tools presented. Naturally, social dynamics also change over time and space, thus changing the potential effectiveness of the tools in different social conditions.

6.2 Implications

This dissertation obtains new insights and knowledge on how to implement processes of social learning based on a conceptual frame structured in recognized education sciences principles of critical education. In light of the positive results that the educational tools obtained in Tanzania, they have been selected for implementation in two new projects. One is the World Wildlife Fund for Nature (WWF) project: Parlu-MATEE (Paraguay Land Use). This project seeks to integrate human activities and forest conservation. Its primary mission is the design and development of measures for integration within the REDD+ focus (Reducing Emissions from Deforestation and Degradation), using an approach adaptable for various political, social, and economic factors, promoting empowerment at community level. Parlu-MATEE is funded by the German Federal Ministry of the Environment, Nature Conservation and Nuclear Safety. The second is the “Implementing sustainable agricultural and livestock systems for simultaneous targeting of forest conservation for climate change mitigation (REDD+) and peace-building in Colombia” project. In both projects, the author was invited to conduct research activities and interventions based on the findings of this dissertation.

6.3 Final remarks

In the context of sustainable development challenges, a confluence of existing pressures and multiple views can be tackled with social learning. However, social learning principles and operationalization still need to be better understood. Implementing process of social learning based on a critical education approach was effective for holistically tackling key determinants of poverty and hunger, integrating the perspectives of multiple social actors regarding contextual factors (articles 3 and 4) (hypothesis 1 and 2).

From the research developed in this dissertation, it is possible to provide evidences that there are principles and process that can facilitate and increase social learning process in SDGs projects. Therefore, the key principles for social learning are:

Principle 1

Social learning occurs when different actors can negotiate rules, norms, power relations (Rist et al. 2007) and strategies of their own development.

Principle 2

Social learning is an integral part of the make-up of concerted action (Colin and Ison, 2009) based in mental schemes. As a process of integration of knowledge, it explores insights into the causes and the means required to transform a situation.

Principle 3

In social learning for community-based strategies development, the goals negotiated between different actors must be compatible with the community system and its operation.

Considering these principles, the use of terms such as “knowledge transfer” or “technology dissemination” in sustainable development projects, should be epistemologically reviewed and questioned in order to avoid promoting an image of community people as “knowledge receptors” instead of the protagonists, the ones with the determinant structures to create their sustainable strategies.

In terms of social learning processes, it requires three main steps. The first, in order to develop a process of social transformation that promotes SDGs, it is fundamentally important to reach the meaningful context of project participants. With this step, a process of codification is initiated, after which decodification should be continued (articles 2 and 3). To identify and recognize this knowledge properly is the primary pedagogical phase for participation and social learning processes in sustainable development projects. The second pedagogical phase has to be then based on the development of local solutions by community members based on their own critical understanding of their own living conditions, and congruent with the community system. Finally, through a process conscientization, a reframing of the community future can occur, potentially increasing ownership (article 3). Following these pedagogical phases, educational tools based on the constructivism paradigm can be operationalized in order to create community-based strategies (hypothesis 1). They are shown as effective in identifying contextual factors of complex problems and to integrating different voices, thus both potentially impacting and benefiting the project’s performance (article 3). Finally, to implement SDGs, projects must combine the perceptions of both experts and community experts, with the use of ScalA tools shown as an effective approach (article 4). This third step helps to foster the process of social learning in terms of integrating the perceptions of different social actors and promoting a mutual negotiation of conditions and strategies for sustainable development.

Promoting sustainable community development is a long process. Although centuries of sub development and hunger cannot be remedied in workshops, single projects, or short-term interventions, it is possible to improve and strengthen both community confidence and consciences (Osnes, 2013). By intentionally promoting social learning process related to food security and climate adaptation issues, community development can be better understood and promoted. This is a crucial issue for research that seeks be to socially relevant and have real-world impacts.

7

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9

Annex

9.1 SDGs 2 and 13 indicators

Goal 2: End hunger, achieve food security and improved nutrition, and promote sustainable agriculture

2.1 by 2030 end hunger and ensure access by all people, in particular the poor and people in vulnerable situations including infants, to safe, nutritious and sufficient food all year round

2.2 by 2030 end all forms of malnutrition, including achieving by 2025 the internationally agreed targets on stunting and wasting in children under five years of age, and address the nutritional needs of adolescent girls, pregnant and lactating women, and older persons

2.3 by 2030 double the agricultural productivity and the incomes of small-scale food producers, particularly women, indigenous peoples, family farmers, pastoralists and fishers, including through secure and equal access to land, other productive resources and inputs, knowledge, financial services, markets, and opportunities for value addition and non-farm employment

2.4 by 2030 ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters, and that progressively improve land and soil quality

2.5 by 2020 maintain genetic diversity of seeds, cultivated plants, farmed and domesticated animals and their related wild species, including through soundly managed and diversified seed and plant banks at national, regional and international levels, and ensure access to and fair and equitable sharing of benefits arising from the utilization of genetic resources and associated traditional knowledge as internationally agreed

Goal 13: Take urgent action to combat climate change and its impacts

13.1 Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries

13.2 Integrate climate change measures into national policies, strategies and planning

13.3 Improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning

13.a Implement the commitment undertaken by developed-country parties to the United Nations Framework Convention on Climate Change to a goal of mobilizing jointly \$100 billion annually by 2020 from all sources to address the needs of developing countries in the context of meaningful mitigation actions and transparency on implementation and fully operationalize the Green Climate Fund through its capitalization as soon as possible

13.b Promote mechanisms for raising capacity for effective climate change-related planning and management in least developed countries and small island developing States, including focusing on women, youth and local and marginalized communities

Source: Agenda 2030

9.2 Field research pictures



Picture 1: Tanzanian participants identify community characteristics in the step 2 of educational tools implementation (workshops, October 2016). Source: personal archive



Picture 2: Tanzanian participant's rehearsal for the Theatre of Oppressed scene in the step 3 of educational tools implementation (workshops, October 2016). Source: personal archive



Picture 3: Tanzanian participants representing the scene in the step 4 of the educational tools implementation (workshops, October 2016).



Picture 4: Tanzanian participants representing conflicts situations in the step 4 of educational tools implementation (workshops, October 2016). Source: personal archive



Picture 5: Tanzanian participants representing diseases and hunger situations in the step 4 of educational tools implementation (workshops, October 2016). Source: personal archive



Picture 6: Tanzanian participants explain the solutions for their problems step 5 of educational tools implementation (workshops, October 2016). Source: personal archive

Eigenständigkeitserklärung:

Hiermit erkläre ich, die Dissertation selbstständig und nur unter Verwendung der angegebenen Hilfen und Hilfsmittel angefertigt zu haben. Ich habe mich anderwärts nicht um einen Doktorgrad beworben und besitze keinen entsprechenden Doktorgrad.

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I hereby declare that I completed the doctoral thesis independently based on the stated resources and aids. I have not applied for a doctoral degree elsewhere and do not have a corresponding doctoral degree.

I have not submitted the doctoral thesis, or parts of it, to another academic institution and the thesis has not been accepted or rejected. I declare that I have acknowledged the Doctoral Degree Regulations which underlie the procedure of the Faculty of Agricultural and Horticultural Sciences (Humboldt-University), as amended on 14th July 2005.

Furthermore, I declare that no collaboration with commercial doctoral degree supervisors took place, and that the principles of Humboldt-Universität zu Berlin for ensuring good academic practice were abided by.

Berlin, 28.06.2018

Michelle Bonatti.....

(Unterschrift der Kandidatin/ signature of the candidate)